It follows therefore from the experiments that the temperature T_{SS} is the same for the spins of F and Li not only at the first instant after the ADRF, but also during the course of the entire process of establishment of equilibrium with the lattice. By the same token, this demonstrates convincingly that a single SS reservoir exists for all the nuclear spin in the crystal also without cross relaxation.

We note that in stationary saturation of the NMR line of F on the wing, its indication signal P(Δ) vanishes for all values of Δ, and the NMR signal of Li remains at equilibrium. This is understandable, for in this case, owing to the relatively strong coupling between the SS reservoir and the lattice ($T_1/T_1' \gg 1$), the value of T_0/T_{SS} changes little [8 - 10], and its influence on the NMR signal of Li is negligible.

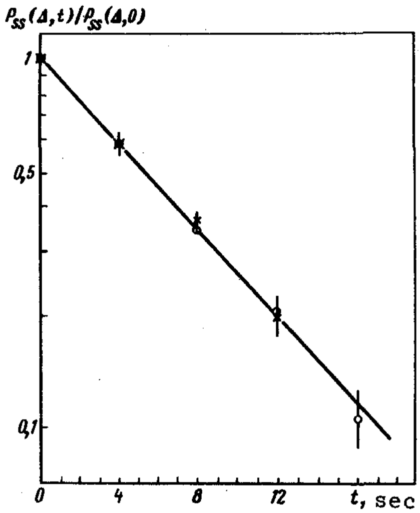

Fig. 2. Decay of spin-spin components $P_{SS}(\Delta, t)$ of the NMR absorption signals P(Δ, t) of F^{19} and Li^7 after ADRF of the F^{19} spins. o - experimental values of $P_{SS}(\Delta, t)/P_{SS}(\Delta, 0)$ for F; × - the same for Li.

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HYPERSOUND ABSORPTION IN DIAMOND

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An investigation of the absorption of hypersound waves in dielectric single crystals yields information on the mechanism of elastic losses at ultrahigh frequencies. There are many published reports of experimental studies of the absorption of hypersound in various single crystals in a wide range of frequencies and temperatures. No such investigations were made for diamond, however. Yet diamond occupies a special place among the dielectric single crystals. The Debye temperature θ and the thermal conductivity κ, the values of which are directly connected with the elastic properties, are much higher in this crystal than in other dielectrics ($\theta \approx 2240°$ [1]; $\kappa \approx 30 - 100$ W/cm-deg [2]). It is therefore of interest to investigate experimentally the absorption of hypersound in diamond.

We used two diamonds from the Yakutsk field, with good natural faceting in the form of octahedra. X-ray diffraction studies have confirmed that the faces of the octahedra are (111) planes. The sufficient planarity and parallelism of the faces have made it possible to dispense with additional optical finishing. The characteristic dimensions along the [111] directions were 4 - 6 mm.

To excite longitudinal hypersound waves in the investigated samples, we used converters in the form of thin ZnO films [3] deposited on Al substrated. An electric microwave field was produced in the film [3] deposited on Al substrated. An electric microwave field was produced in the film by means of a tunable coaxial element. The measurements were made at 3 and 8 GHz by the usual echo-pulse method in the temperature interval 4.2 - 300°K.

Figure 1 shows the temperature dependence of absorption of longitudinal hypersound waves in diamond. For comparison, the figures shows the analogous plot for single-crystal Al_2O_3. It follows from the figure that in diamond the region of strong temperature dependence of the absorption is shifted toward the higher temperatures by approximately 100° and a noticeable absorption appears at T > 120°K.

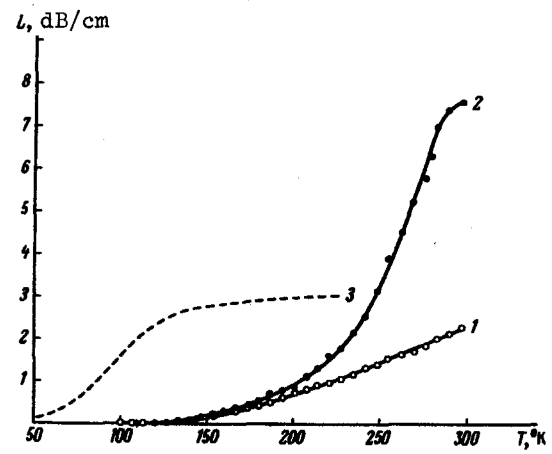

Fig. 1. Temperature dependence of the damping of longitudinal waves propagating in diamond along the [111] axis: 1 - 3 GHz, 2 - 8 GHz, 3 - 3 GHz (Al_2O_3).

At room temperature, the absorption at 3 GHz still does not reach the maximum value, and amounts to 2.2 dB/cm; at 8 GHz its value is 7.5 dB/cm. A comparison of these data indicates that, unlike some other crystals, in which a quadratic frequency dependence of the absorption appears at room temperature, the absorption in diamond decreases more slowly than ω^2.

We excited transverse hypersonic waves of 8 GHz frequency in the same samples, using thin-film nickel converters. Measurements have shown that the transverse waves attenuate much more weakly than the longitudinal ones at this frequency.

For frequencies and temperatures at which the relation $\omega\tau < 1$ ($\tau = 3\kappa/C\bar{v}^2$ is the thermal relaxation time, κ the lattice thermal conductivity, C the specific heat per unit volume, and $\bar{v}$ the average speed of sound in the Debye approximation) the absorption of longitudinal hypersonic waves can be determined by an expression based on the Akhiezer model [4, 5]

$$L\,(\text{dB/cm}) = \frac{8{,}68\,\gamma^2}{\rho \bar{v}^5} 3\omega^2 \kappa T\,, \qquad (1)$$

where $\gamma^2 = (T/\theta)^3 \tilde{\gamma}^2$, $\tilde{\gamma}$ is the average value of the Gruneisen constant, ρ is the density, and T is the absolute temperature.

For our measurements, the relation $\omega\tau < 1$ is satisfied only at 3 GHz and at T > 170°K. Using the data of [1, 2], we can calculate the temperature dependence of the absorption. It is seen from Fig. 2 that the values of the absorption calculated for $\tilde{\gamma} \simeq 6$ are in fully satisfactory agreement with the measured ones.

The experimental results offer evidence that diamond has a lower absorption than any other crystal.

In conclusion, the authors thank N.L. Kenigsberg for help with the work.

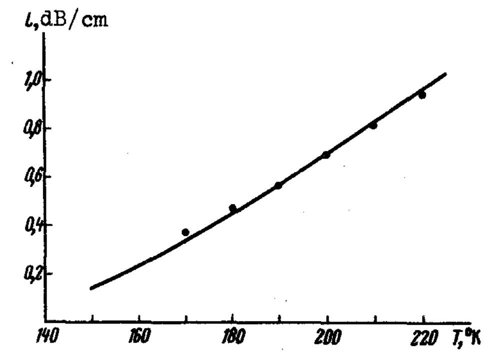

Fig. 2. Comparison of the experimental and calculated values of the damping of longitudinal waves in diamond at 3 GHz. Curve - theory, points - experiment.

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ANGULAR ANISOTROPY AND SPIN OF THE TARGET NUCLEUS IN (n, f) REACTIONS

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One of the factors determining the angular anisotropy of fission is the alignment of the angular momentum $\mathcal{J}$ of the compound nucleus relative to a preferred direction in space, namely that of the beam of the bombarding particles. A random distribution of the spins of the target nuclei should lead to a decrease of the angular anisotropy of the fission. The effect of the spin depends strongly on the distribution of the K-projection of the total angular momentum $\mathcal{J}$ of the compound nucleus on the symmetry axis [1]. In the case of statistical distribution of K [2]

$$\phi(K) \sim \exp[-K^2/2K_0^2] \qquad (1)$$

the coefficient of the angular anisotropy can be approximately represented by the quasiclassical expression [1, 3]

$$A = \frac{W(0°)}{W(90°)} - 1 \approx \frac{L}{4K_0^2}\left[1 + \frac{L - 2I_0(I_0 + 1)}{18K_0^2}\right], \qquad (2)$$

where $L = \overline{\ell(\ell + 1)}$ is the mean square of the angular momentum transferred to the nucleus, I_0 is the spin of the target nucleus, and $K_0^2 = \overline{K^2}$.

The first attempts to observe the influence of the spin on the angular anisotropy of the outgoing fragments were undertaken for the reactions where $U^{233}(5/2^+)$, $U^{235}(7/2^-)$, and $Pu^{239}(1/2^+)$ were fissioned by fast neutrons of several MeV energy [4]. The observed effect turned out to have the opposite sign. This fact was later interpreted [5] as the result of a dependence of the moment of inertia J_{eff} ($K_0^2 \sim J_{eff}$) on Z^2/A of the fissioning nucleus.